SOME MORPHOLOGICAL ADJUSTMENTS MADE BY CERTAIN CORN HYBRIDS WHEN GROWN IN THE SAME AND SEPARATE HILLS AT VARIOUS POPULATIONS

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ASTON RUPERT TAYLOR

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SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN AGRONOMY
IN THE GRADUATE COLLEGE OF THE
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With the introduction of hybrid corn and the more extensive use of fertilizer, especially nitrogen, has come a change in the acre yield potentialities. Research has established that variations in stand have a much greater effect on grain yield at high than at low soil productivity levels. Irrespective of the level of soil fertility, different hybrids show wide variations in performance when grown at the same population, particularly if the population per acre is high.

The importance of planting patterns in the production of high corn yields has been stressed by many workers. The results obtained, coupled with a knowledge of the nature and inheritance of the hybrids should result in practices giving the highest acre yields. Intense as has been these studies, relatively no specific information is yet available on the morphological adjustments made by corn to varying intensities of field stand. The author believes that much of the lack of specific data on the correlation between the morphological adjustment of plants and their performance may result from the complex nature of such characters as plant size, yield and rate of development.

Methods

This exploratory study was divided into four phases with the view to getting more definite information on the nature of the adjustments made by corn hybrids of different breeding to varying planting rates. With results obtained it was hoped to be able to account for the differences in yield among hybrids at different population levels. Accordingly, observations were made on ten single-cross hybrids at varying stages of development.

One phase included germination studies which were made using three of these hybrds, $Hy_2 \times Oh_7$, a comparatively high grain producer, $Hy_2 \times$ L317, a medium performing single-cross, and $WF_9 \times$ C103, a low performing hybrid at high planting rates. These included observations on the rates of moisture absorption of the kernels in a cabinet germinator, the percentage germination of each hybrid after 48 hours, the rates of plumule and radicle elongation, the development of seminal and cotyledonary roots, and finally ascertaining the sprout value after two weeks of growth.

Kernels of the three hybrids used in the germination study were grown in the greenhouse in pots as the second phase of this investigation. The pots contained uniform and equal amounts of soil, and plants were grown at four population rates, 2, 4, 6 and 8 per pot. The hybrids were grown individually, and in various combinations at these planting rates. Data were taken on plant heights every third day to study the effect of competition within and between hybrids at the four rates of planting. The ear height and the ear-to-tassel distance of individual plants were found after growth had ceased. The dry weight of each plant was recorded, and root size differences were compared in the three hybrids.

The third phase consisted of field studies which were conducted on one level of soil fertility to test the application of the greenhouse observations, and to observe any further adjustments which the plants made to different levels of competition. Root size, stem diameter, ear and kernel size and internode lengths at the varying populations were compared.

The final phase involved a field study of nine hybrids including, $Hy_2 \times Oh_7$, $Hy_2 \times$ L317, and $WF_9 \times$ C103, at six rates of planting; namely, 1 to 6 plants per hill, on three levels of soil fertility, high, medium and low. Plant height at maturity, the ear height, the distance from the ear to the tassel and the yield in bushels per acre were taken. All data were statistically analyzed in an attempt to establish correlations between the adjustment of plant parts and performance

at different planting rates.

Results

Under the conditions of these experiments, the following trends were evident:

1. The rate of germination was affected, directly, by the rate of water absorption by the kernels on the germinator, and inversely, by the specific gravity of the kernels.

2. Corn seedlings showed differential response in plumule and radicle elongation as influenced by the space between the germinating kernels.

3. The degree of initiation and growth of seminal and cotyledonary roots showed a positive correlation to yield, and the number of cotyledonary roots bore a stronger positive relationship to yield at the higher plant populations.

4. The three hybrids, $Hy_2 \times Oh_7$, $Hy_2 \times$ L317 and $WF_9 \times$ C103, showed marked differences in the height adjustments, and especially in the ear-to-tassel distance at the higher planting rates. This trend was more pronounced in the greenhouse studies but applied to all the hybrids observed under field conditions.

5. A great reduction in the ear-to-tassel distance was associated with a tendency to maintain ear size, and yield at the higher planting rates.

6. From the observations made above (No. 5), it was postulated that the peculiar reduction in corn height under competition was largely due to the nutritional factor. Further, reduced nutrition, due to competition, apparently restricted the translocation of food to the upper part of the plant. The translocation of nutrients favoured ear development, at the expense of stem elongation, at higher plant populations.

7. On the highly productive plot the highest average yield

was obtained at a planting rate of 16,000 plants to the acre or 4 plants to the hill. Both on the medium and low productive plot, maximum yield was obtained at 12,000 plants to the acre or 3 plants per hill.

8. The individual hybrids ranked approximately the same in yield of grain at all three fertility levels, but they responded differently at different planting rates.

9. With increasing competition between plants there was a significant reduction in root size, stem diameter, kernel size, and in elongation of the internode below the ear.

10. This study pointed to the possibility of producing corn hybrids which could maintain appreciably high yields at high planting rates by selecting inbreds with the capacity to reduce plant height under competition, and to direct reserves from stem elongation to ear production.

VITA

Aston Rupert Taylor was born on November 2, 1915, in Jamaica, British West Indies. He received his earliest education under his parents; and, after completing the eight grade, entered Huntsden High School in Kingston. In 1934, he entered the Mico Training College, a training center for male teachers on the Island, and graduated in 1937 with a First Class diploma. For the next eight years he was Principal, successively, of two Public Elementary Schools in Jamaica.

In 1945, he was on study leave at McGill University, Canada, and took a four year course in Genetics and Plant Breeding. Graduating in May, 1949, with a B.S. (Honours), he entered the University of Alberta, Canada, completed the requirements for the M.S. and received the degree in October, 1950.

Returning to Jamaica in 1950, he was temporarily employed as an Agricultural Officer in the Department of Agriculture, and held the post for eight months. In September, 1951, he entered the University of Illinois, registering for the Ph.D. in Agronomy (Crop Production) with minors in Botany (Physiology) and Agronomy (Soils).

Aston is a member of the Jamaica Union of Teachers, the Science Association of the University of Alberta, the Agricultural Institute of Canada, and Gamma Sigma Delta. At the beginning of the third graduate year he was awarded the Booth Fellowship in Agronomy at the University of Illinois.